

## Electrostatics

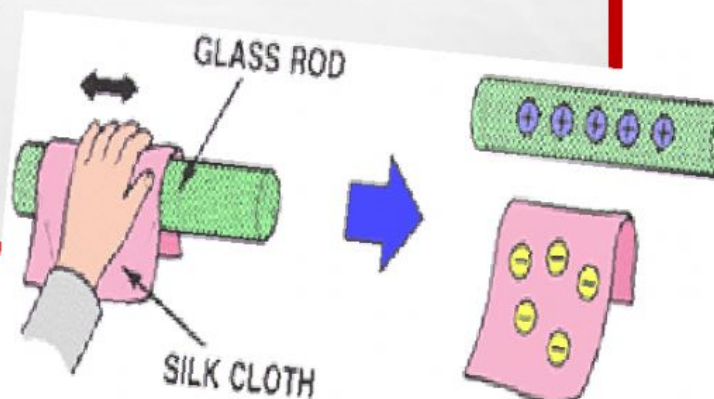
### ELECTROSTATIC FORCE

- It is a non contact force (      force)
- It is the force that two electrically charged objects exert on each other over a distance
- These forces act in an electrostatic field (this field is found around any charged object)



### HOW DOES AN OBJECT BECOME CHARGED?

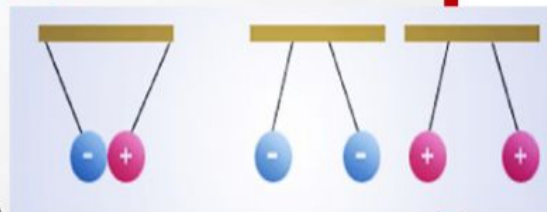
- In an atom, number of PROTONS = number of      therefore the atom is electrically neutral
- Electrons can be removed or added to the surface of a substance easily by rubbing two substances together
- A substance that gains electrons becomes      charged
- A substance that loses electrons becomes      charged



# LIKE AND UNLIKE CHARGES

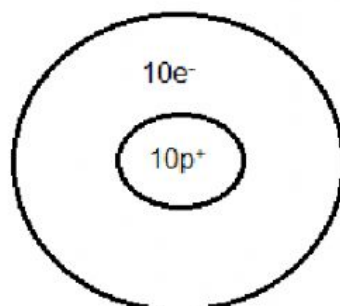
Electrostatic force can be:

- a force of  (between unlike charges, i.e. + and -)
- a force of  (between like charges, i.e. + and + OR - and -)



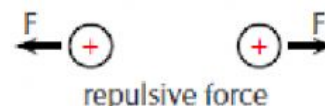
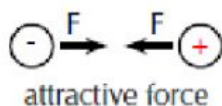
So:

- Objects that are neutrally charged have an equal number of  and .  
The number of neutrons does not affect the charge since they have no charge.



- Two objects with the same charge will  each other
- And two objects with different charges would  each other

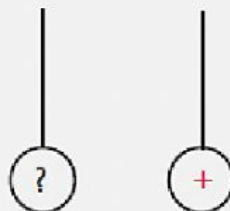
In other words, like charges **repel** each other while opposite charges **attract** each other.



- Objects can become charged through friction.
- When an object                      electrons it becomes positively charged
- When an object                      electrons it becomes negatively charged.



Two charged metal spheres hang from strings and are free to move as shown in the picture below. The right hand sphere is positively charged. The charge on the left hand sphere is unknown.



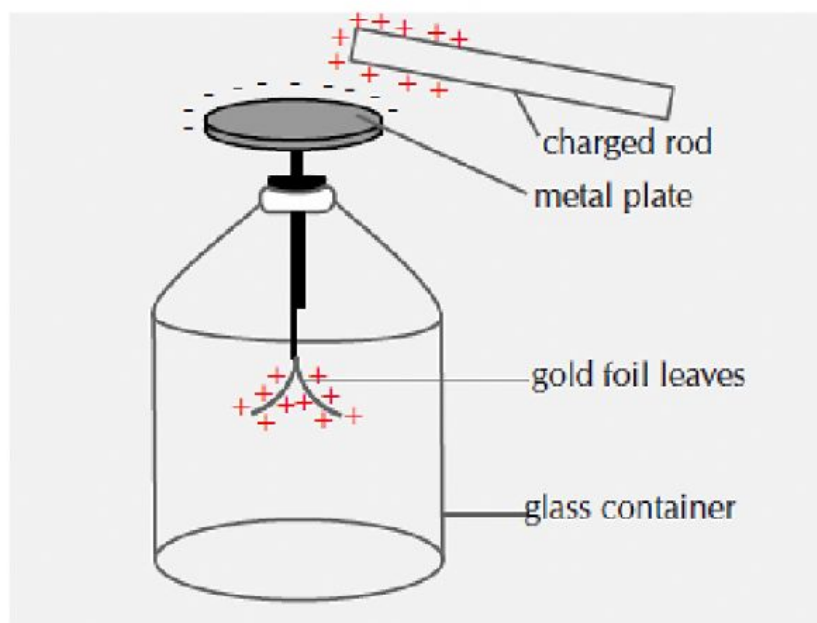
The left sphere is now brought close to the right sphere.

1. If the left hand sphere swings towards the right hand sphere,  
what can you say about the charge on the left sphere Negative / positive
2. If the left hand sphere swings away from the right hand sphere,  
what can you say about the charge on the left sphere Negative / positive

- a. In the first case, the positively charged sphere is attracting the left sphere. Since an electrostatic force between unlike charges is attractive, the left sphere must be *negatively* charged.
- b. In the second case, the positively charged sphere repels the left sphere. Like charges repel each other. Therefore, the left sphere must now also be *positively* charged.

## The electroscope

The electroscope is a very sensitive instrument which can be used to detect electric charge. A diagram of a gold leaf electroscope is shown in the figure below. The electroscope consists of a glass container with a metal rod inside which has 2 thin pieces of gold foil attached. The other end of the metal rod has a metal plate attached to it outside the glass container.

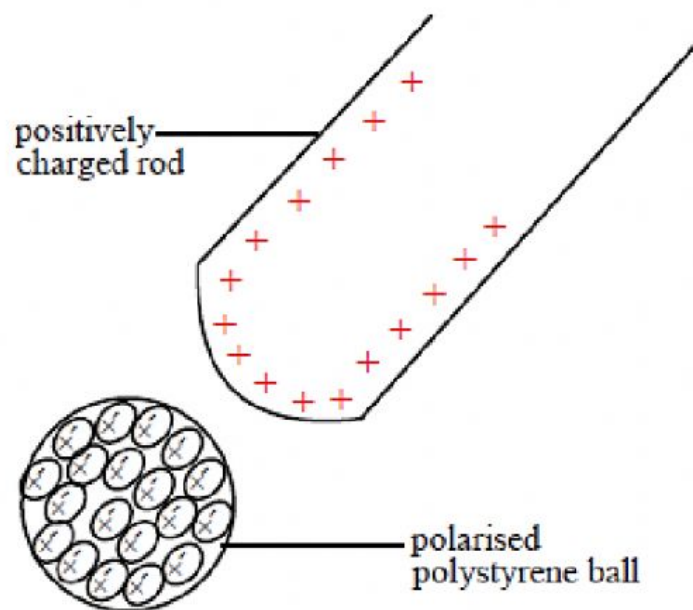




## Polarisation

Unlike conductors, the electrons in insulators (non-conductors) are bound to the atoms of the insulator and cannot move around freely through the material. However, a charged object can still exert a force on a neutral insulator due to a phenomenon called **polarisation**.

If a positively charged rod is brought close to a neutral insulator such as polystyrene, it can attract the bound electrons to move round to the side of the atoms which is closest to the rod and cause the positive nuclei to move slightly to the opposite side of the atoms. This process is called *polarisation*. Although it is a very small (microscopic) effect, if there are many atoms and the polarised object is light (e.g. a small polystyrene ball), it can add up to enough force to cause the object to be attracted onto the charged rod. Remember, that the polystyrene is *only* polarised, *not* charged. The polystyrene ball is still neutral since no charge was added or removed from it. The picture shows a not-to-scale view of the polarised atoms in the polystyrene ball:



### **Polarisation:**

In a conducting object, electrons move across the surface of the conductor. In an insulator, electrons rearrange themselves within the molecules on the outer surface of the object causing polarisation. Attraction is then possible. E.g. water and charged rod.